



AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

- 1.(Currently Amended)      A communication unit for a multiple code rate communication system comprising:
  - a codeword defining  $N$  codeword elements and  $K$  information elements coded at a code rate  $R=K/(N-P)$ , wherein  $P$  is a number of punctured elements of the codeword;
  - a first storage location for storing an error reduction code mother code definition;
  - a second storage location for storing a maximum puncture sequence  $S_{\max}$ , wherein  $S_{\max}$  is the puncture sequence for a maximum code rate  $R_{\max}$ , and further wherein  $S_{\max}$  comprises a subset  $S_1$  that is a puncture sequence for a minimum code rate  $R_1$ , wherein the codeword is one of decoded or encoded through the error reduction code mother code definition read from the first storage location and a selected one of puncturing sequences  $S_1, S_2, \dots, S_{\max}$  read from the second storage location.
- 2.(Original)      The communication unit of claim 1 wherein the unit is one of a transmitter that outputs the codeword or a receiver that receives the codeword.
- 3.(Original)      The communication unit of claim 1 wherein  $S_{\max}=S_{N-K}$ .
- 4.(Previously Presented)      The communication unit of claim 1 wherein  $S_{\max}$  further comprises at least two subsets  $S_i$  that are puncture sequences for code rates  $R_i$ , wherein  $i$  is an integer greater than or equal to one and each sequentially higher  $i^{\text{th}}$  code rate is higher than the sequentially lower  $i^{\text{th}}$  code rate.
- 5.(Original)      The communication unit of claim 4 wherein each  $S_i$  comprises at least one memory element, and each  $S_i$  with at least two memory elements has at least one memory element in common with another  $S_i$  and with  $S_{\max}$ .
- 6.(Original)      The communication unit of claim 4 wherein  $S_1 \subseteq S_2 \subseteq \dots \subseteq S_{\max-1} \subseteq S_{\max}$ .

- 7.(Original) The communication unit of claim 1 wherein the second storage location comprises a plurality of memory elements for storing  $S_{\max}$ , each memory element storing a variable degree.
- 8.(Original) The communication unit of claim 1 wherein the second storage location comprises a plurality of memory elements for storing  $S_{\max}$ , each memory element storing a variable node location.
- 9.(Original) The communication unit of claim 1 wherein the second storage location comprises a plurality of memory elements for storing  $S_{\max}$ , each memory element storing one of a variable degree, a check degree, a variable node location, or a check node location.
- 10.(Original) The communication unit of claim 1 wherein the error reduction code mother code is a low-density parity-check (LDPC) mother code.
- 11.( Previously Presented) A transceiver for transmitting and receiving a codeword at any of three coding rates  $R_1$ ,  $R_2$  and  $R_3$ , wherein the codeword defines  $N$  codeword elements,  $K$  information elements, and  $P$  punctured elements, and the coding rates  $R_1=K/(N-P_1) < R_2=K/(N-P_2) < R_3=K/(N-P_3)$ , comprising:
- a transmitter, a receiver, and storage for storing a low-density parity-check (LDPC) mother code definition;
  - a plurality of memory elements that in combination store a puncture sequence  $S_3$  that corresponds to  $R_3$ ;
  - a first set of computer instructions for retrieving a first subset of the plurality of memory elements to yield a puncture sequence  $S_1$  that corresponds to  $R_1$ ; and
  - a second set of computer instructions for retrieving a second subset of the plurality of memory elements to yield a puncture sequence  $S_2$  that corresponds to  $R_2$ .
- 12.(Previously Presented) A computer program embodied on a computer readable medium for determining a puncture sequence for a codeword, comprising:
- a first storage location for storing a low-density parity-check (LDPC) mother code definition;

a second storage location for storing a plurality of memory elements  $M_{all}$  that in combination comprise a maximum rate puncture sequence  $S_{max}$  that corresponds to a maximum code rate  $R_{max}$ ; and

a first set of computer instructions for reading a first subset of memory elements  $M_{set1}$ , wherein the number of  $M_{set1}$  is less than the number of  $M_{all}$ , wherein  $M_{set1}$  comprises a puncturing sequence  $S_1$  that corresponds to a code rate  $R_1 < R_{max}$ .

13.(Original) The computer program of claim 12 further comprising a second set of computer instructions for reading a second subset of memory elements  $M_{set2}$ , wherein the number of  $M_{set2}$  is greater than the number of  $M_{set1}$ , wherein  $M_{set2}$  comprises a puncturing sequence  $S_2$  that corresponds to a code rate  $R_2 > R_1$ , and further wherein at least one memory element is a memory element of both  $M_{set1}$  and  $M_{set2}$ .

14.(Original) A method for determining a puncture sequence for an ensemble of low-density parity-check (LDPC) codes comprising:

selecting at least one design criteria for an ensemble of LDPC codes and a stop criteria;

calculating a mean input LLR values,  $m_{u_0}$ , that achieves the design criteria on the ensemble of codes;

selecting a variable degree  $j$  within the design criteria for puncturing that requires one of a smallest mean input LLR value or a smallest decoding complexity;

appending the variable degree to the puncturing sequence;

adjusting the puncturing probability for the punctured variable degree,  $\pi_j^{(0)}$ ;

and

repeating the calculating and subsequent steps until the stop criteria is reached.

15.(Original) The method of claim 14 wherein adjusting the puncturing probability for the punctured variable degree,  $\pi_j^{(0)}$  includes accounting for a specific code length and a finite number of variable nodes of each variable degree.

16.(Original) The method of claim 14 wherein the stop criteria comprises a code rate equal to one.

17.(Original) The method of claim 14 wherein the stop criteria comprises a length of a puncturing sequence that corresponds to a Binary Erasure Channel (BEC) threshold for random errors.

18.(Original) The method of claim 17 wherein the stop criteria comprises a fraction of punctured variable nodes that reaches or exceeds the BEC threshold.

19.(Original) The method of claim 14 wherein the at least one design criteria is selected from at least one of the group consisting of: a target bit error rate (BER) within a finite number of iterations; an asymptotic  $E_b/N_0$  threshold; and a number of decoding iterations for a target BER.

20.(Previously Presented) A transmitter comprising:

an information source for providing a codeword;

a memory for storing a low density parity check code LDPC mother code definition and a maximum puncture sequence  $S_{\max}$ ;

a LDPC encoder having an input coupled to an output of the information source and an input coupled to an output of the memory; and

a modulator having an input coupled to an output of the LDPC encoder,

wherein the encoder operates in one instance to encode at a maximum rate  $R_{\max}$  by puncturing elements of a codeword in locations described by the maximum puncture sequence  $S_{\max}$  read from the memory, and in another instance to encode at a lesser rate  $R_1$  by puncturing elements of a codeword in locations described by a subset  $S_1$  of the maximum puncture sequence  $S_{\max}$  read from the memory.

21.(Previously Presented) The transmitter of claim 20, wherein the encoder encodes at any of rates  $R_{\max}$ ,  $R_3$ ,  $R_2$ , and  $R_1$  by puncturing elements of a codeword in locations described by the respective sequences  $S_{\max}$ ,  $S_3$ ,  $S_2$ , and  $S_1$ , wherein  $R_{\max} > R_3 > R_2 > R_1$  and  $S_1 \subseteq S_2 \subseteq S_3 \subseteq S_{\max}$ .

22.(Previously Presented) The transmitter of claim 20, wherein the encoder encodes at any of rates  $R_{\max}$ ,  $R_3$ ,  $R_2$ , and  $R_1$  by puncturing elements of a codeword in locations described

by the respective sequences  $S_{\max}$ ,  $S_3$ ,  $S_2$ , and  $S_1$ , wherein  $R_{\max} > R_3 > R_2 > R_1$  and each of  $S_1$ ,  $S_2$  and  $S_3$  are subsets of  $S_{\max}$  but not subsets of any of the other of  $S_1$ ,  $S_2$  and  $S_3$ .

23.(Previously Presented) A receiver comprising:

a demodulator for demodulating a received codeword;

a memory for storing a low density parity check code LDPC mother code definition and a maximum puncture sequence  $S_{\max}$ ; and

a LDPC decoder having an input coupled to an output of the demodulator and an input coupled to an output of the memory;

wherein the decoder operates in one instance to decode at a maximum rate  $R_{\max}$  by de-puncturing elements of a codeword in locations described by the maximum puncture sequence  $S_{\max}$  read from the memory, and in another instance to decode at a lesser rate  $R_1$  by de-puncturing elements of a codeword in locations described by a subset  $S_1$  of the maximum puncture sequence  $S_{\max}$  read from the memory.

24.(Previously Presented) The receiver of claim 23, wherein the decoder decodes at any of rates  $R_{\max}$ ,  $R_3$ ,  $R_2$ , and  $R_1$  by de-puncturing elements of a codeword in locations described by the respective sequences  $S_{\max}$ ,  $S_3$ ,  $S_2$ , and  $S_1$ , wherein  $R_{\max} > R_3 > R_2 > R_1$  and  $S_1 \subseteq S_2 \subseteq S_3 \subseteq S_{\max}$ .

25.(Previously Presented) The receiver of claim 23, wherein the decoder decodes at any of rates  $R_{\max}$ ,  $R_3$ ,  $R_2$ , and  $R_1$  by de-puncturing elements of a codeword in locations described by the respective sequences  $S_{\max}$ ,  $S_3$ ,  $S_2$ , and  $S_1$ , wherein  $R_{\max} > R_3 > R_2 > R_1$  and each of  $S_1$ ,  $S_2$  and  $S_3$  are subsets of  $S_{\max}$  but not subsets of any of the other of  $S_1$ ,  $S_2$  and  $S_3$ .

26.(Currently Amended) The communication unit of claim 4 wherein each  $S_i$  comprises at least one memory element, and there is at least one  $S_i$  ~~with at least one memory element~~ that has no memory elements in common ~~is not shared~~ with another  $S_i$ .

27.(New) The communication unit of claim 4, wherein the subset  $S_i$  corresponds to a puncture sequence representing non-zero element locations in a column of a check parity matrix.

28. (New) The communication unit of claim 4, wherein the subset  $S_i$  corresponds to a puncture sequence representing a number of non-zero elements in a column of a check parity matrix.

29. (New) The communication unit of claim 4, wherein different combinations of columns of a check parity matrix correspond to different subsets  $S_i$  and all columns of the check parity matrix correspond to the maximum puncture sequence  $S_{\max}$ .

30. (New) A method for operating a communication unit at multiple code rates comprising:

receiving a codeword defining  $N$  codeword elements and  $K$  information elements coded at a code rate  $R=K/(N-P)$ , wherein  $P$  is a number of punctured elements of the codeword;

retrieving an error reduction code mother code definition from a first storage location;

retrieving a puncture sequence from a second storage location, wherein the puncture sequence retrieved from the second storage location is a selected one of a maximum puncture sequence  $S_{\max}$  for a maximum code rate  $S_{\max}$  and a minimum puncture sequence  $S_1$  for a minimum code rate  $R_1$  and  $S_1$  is a subset of  $S_{\max}$  and  $S_1$  corresponds to a column of a check parity matrix.